IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Group Art Unit: 1714

ANDREAS BACHER ET AL.

Examiner: Vickey M. Ronesi

Serial No.: 10/618,936

Filed: July 14, 2003

For: SILANE-CONTAINING POLYVINYL ALCOHOL FOR COATING SLIPS

Attorney Docket No.: WAS 0595 PUS

APPEAL BRIEF UNDER 37 C.F.R. § 41.37

Mail Stop Appeal Brief - Patents
Commissioner for Patents
U.S. Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This is an Appeal Brief from the final rejection of claims 1, 4 - 7, 10 - 17, and 21 - 23 of the Office Action mailed on August 28, 2008 for the above-identified patent application.

I. REAL PARTY IN INTEREST

The real party in interest is Wacker Chemie AG ("Assignee"), a corporation organized and existing under the laws of Germany, and having a place of business at Hanns-Seidel-Platz 4, Müenchen, Germany, as set forth in the assignment recorded in the U.S. Patent and Trademark Office on October 1, 2008 at Reel 021603/Frame 0608.

II. RELATED APPEALS AND INTERFERENCES

There are no appeals, interferences or judicial proceedings known to the Appellant, the Appellant's legal representative, or the Assignee which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1, 4 - 7, 10 - 17, and 21 - 23 are pending in this application. Claims 1, 4 - 7, 10 - 15, 17 and 21 - 23 have been rejected and are the subject of this appeal[1].

IV. STATUS OF AMENDMENTS

No amendment after final rejection has been filed.

V. SUMMARY OF CLAIMED SUBJECT MATTER

The claimed invention is directed to silane-containing polyvinyl alcohol polymers consisting essentially of a completely or partially hydrolyzed vinyl ester copolymer with a degree of hydrolysis of 76 - 100 mol% (page 2, lines 22 - 25) obtained by free radical polymerization of vinyl acetate and from 1 to 30 mol%, based on polymer weight, of 1-methylvinyl acetate, and from 0.01 to 1 mol% (page 7, lines 1 - 3) of ethylenically unsaturated silane-containing monomers (page 2, line 25 to page 3, line 5; page 3, line 26) selected from the group enumerated in claim 1 (claim 5 as filed; page 5, lines 1 - 18).

Claims 5 and 22 further requires a silane monomer to be one of vinyltrimethoxysilane, vinylmethyldimethoxysilane, vinyltriethoxysilane, and vinylmethyldiethoxysilane.

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[1]Claim 16 is not appealed only because it is a duplicate of claim 1, since it fails to further limit that claim.

The modified polyvinyl alcohols are useful as a binder for coating slips (claims 7, 10 as filed; specification page 2, lines 15 - 20).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

A. Claims 1, 4 - 7, 10 - 15, 17 and 21 - 23 stand rejected under 35 U.S.C §112 ¶1 for lack of written description for the numerical claim limitation "1".

B. Claims 1, 4 - 7, 10 - 15, 17, and 21 - 23 stand rejected under 35 U.S.C. § 103(a) over Schilling et al. U.S. 4,879,336 ("*Schilling*") in view of Maruyama et al. U.S. 4,617,239 ("*Maruyama*").

VII. ARGUMENT

A. The Claims Fully Comply With The Written Description Requirement

Claims 1, 4 - 7, 10 - 15, and 17 have been rejected under 35 U.S.C. § 112 ¶1 as failing to comply with the written description requirement. Claims 1 and 17 recite the amount of ethylenically unsaturated silane to be "from 0.01 to 1 mol%". The Office refers to the specification, page 7, line 2, which recites "from 0.01 to 1.<u>0</u> mol%".

This is the second time this case has been before the Board. In the Boards prior decision affirming the rejection of the claims under 35 U.S.C. § 103(a), the Board agreed with the Examiner that Appellants showing of surprising and unexpected results was not commensurate with the scope of the claims, which had recited a silane monomer content of 0.01 to 10 weight percent. Appellants then narrowed the claim to the much narrower range of 0.01 to 1.0 weight percent, the example in the specification being right in the middle of this very

narrow range, and supplied additional examples and comparative examples in the form of the Declaration of Dr. Andreas Bacher (Evidence Appendix) submitted in Appellants' response of May 27, 2008.

It is well established that a later added claim limitation need not be present in the specification "*in haec verba*," see *Fujikawa v. Wattanasin*, 93 F.3d, 1559, 1570; 39 USPQ2d 1895, 1904 (Fed. Cir. 1996), and must only "reasonably convey to the artisan that the inventor had possession . . . of the later claimed subject matter. "*Waldemar Link GmbH & Co. v. Osteonics Corp.*, 32 F.3d 556, 558; 31 USPQ2d 1855, 1857 (Fed. Cir. 1994). In doing so, the specification as a whole must be considered. *In re Wright*, 866 F.2d 422; 9 USPQ2d 1649 (Fed. Cir. 1988).

There is ordinarily no distinction in patent law between 1 and 1.0. The Federal Circuit has held that in an infringement analysis, for example, the range of equivalents is not affected by the number of significant digits in the particular number. In an analysis of a later added claim limitation for compliance with the written description requirement, the question is whether one skilled in the art, reading the specification, would conclude that the inventor was in possession, at the time of filing, of the later added claim limitation.[2]

That is abundantly clear here. The Appellants clearly contemplated the whole range of 0.01 to 10 mol%, of which "1" is within. Moreover, "1.0" is specifically designated. To say the inventor did not contemplate "1" when he stated 1.0 is nonsensical.

Moreover, the Board and the Federal Circuit have both sanctioned the later addition of terms such as "substantially" and "about" to the claims when these terms were not present in the specification. See, *e.g. Ex parte Butler*, 116 USPq 597 (POBA 1957), where the

[2]At any rate, Appellants are completely willing to amend the claim to read "1.0" rather than "1".

specification stated "at least part of the tin [component of a phosphor] must be in the stannous state", and the claim was amended to recite "a substantial part of the tin is present in the stannous state." The word "substantial" did not appear in the specification, and the Examiner rejected the claims under 35 U.S.C. § 112 ¶1. The Board reversed.

If an Appellant is allowed to add "substantially" and other qualifying terms such as "about", he or she is certainly entitled to use "1" instead of "1.0". One skilled in the art, reading the specification is immediately aware that Appellant had posses this range endpoint at the time the application was filed, and thus meets the written description requirement. *Noelle v. Ledermann*, 355 F.3d 1343, 1348 (Fed. Cir. 2004). See also, *Eiselstein v. Frank*, 52 F.3d 1035, 34 USPQ 2d 1467 (Fed. Cir. 1995) ("about 45%" supported by "45%"). Reversal of the rejection under 35 U.S.C. §112 ¶1 is respectfully solicited.

B. The Claims Are Non-Obvious Over *Schilling* In View of *Maruyama*.

In rejecting the claims in the Office Action dated August 28, 2008, the Examiner incorporated the rejection set forth in paragraph 3 of the Office Action of January 31, 2008, incorporating this paragraph by reference.[3]

The subject invention is directed to silane-modified polyvinyl alcohols which are useful, in particular, as binders in coating slips, i.e. coatings which are commonly applied to paper to produce a smooth, ink-receptive surface. Prior art hydrophobicizing binders are typified by those of *Maruyama*, the Japanese priority document of which was published in 1983. However, as indicated at the bottom of page 9 of the subject invention specification, while the claimed binders have excellent storage stability, prior art binders were deficient in

[3]However, in the meantime, the claims had been amended and the Declaration of Dr. Bacher made of record. It does thus not appear that the claims were adequately reconsidered in light of these changes.

this property. In the Examples, a subject invention polymer showed little viscosity increase over time (Table 3, page 13), while a prior art *Maruyama*-type polymer exhibited a severe increase in viscosity, a factor of 3.6 (360%). Appellants discovered that this increase in viscosity can be avoided by incorporating a minor amount of a 1-alkylvinyl ester into the copolymer in addition to the silane moieties. This is a highly surprising and unexpected discovery. Despite the some 19 years between the publication of *Maruyama* and the filing of the Appellants' priority application, no one had disclosed Appellants' method of increasing binder stability.

Schilling discloses conventional polyvinyl alcohols which are modified to contain 1-alkylvinyl ester moieties. In the Office Action of November 23, 2005, the Examiner indicated that *Schilling* teaches improved storage stability: "If applicant is referring to the improved storage stability, such *is* taught by Schilling (col. 2, lines 7-34)." <u>However, this statement is incorrect</u>.

The portion of *Schilling* referred to by the Examiner reads as follows:

> Due to their excellent pigment-binding power and support effect for optical brighteners, two serious disadvantages of these [prior art] cobinders are accepted for industrial application. Fully-saponified polyvinyl alcohols are virtually insoluble in water at room temperature. For conversion into an aqueous solution, a polyvinyl alcohol suspension must be stirred vigorously for a relatively long time at at least 90.degree. C. which ultimately encumbers the papermaking process due to the provision of dissolving stations and additional energy costs. The second disadvantage is linked with "pigment shock". When the polyvinyl alcohol solution is added to the pigment slurry, a momentary steep increase in the viscosity of the coating slips is produced. This can only be decreased rapidly with suitable stirrers which apply very high shear forces, or by adding additional auxiliaries, the so-called "anti-shock agents".
> (Col. 2, lines 7-34.)

Note that there is nothing in this section which pertains to storage stability. In the beginning of the section, the difficulties of dissolving fully hydrolyzed polyvinyl alcohols is alluded to. This low rate of dissolution has nothing to do with storage stability: polyvinyl alcohol solutions, once prepared, are very stable, as is well known to those skilled in the art. The second "disadvantage" of prior polymers which is discussed is "pigment shock," a <u>temporary</u> increase in viscosity upon addition of polyvinyl alcohol solution to a pigment slurry. This momentarily increased viscosity disappears of its own accord over time, and disappears more rapidly upon intensive stirring (ll. 21-23).

As can be seen, this paragraph pertains to prior art, fully hydrolyzed polyvinyl alcohol. *Schilling* improved upon the prior art products by incorporating 1-alkylvinyl esters into the copolymer. This modification of the polymer led to an improved dissolution rate, even allowing the solid polymer to be added directly to the pigment slurry (col. 3, ll. 3-7). The increased dissolution rate is illustrated in Table 2, where the Brookfield viscosity of the copolymers, following addition to water as a solid with stirring, reached high values after only 30 minutes, while the unmodified polyvinyl alcohols did not, indicating that the latter dissolve very slowly, acting as fillers (col. 4, ll. 66-68) over this limited dissolution time.

There is no indication anywhere in *Schilling* that his copolymers are more (or less) stable than conventional polyvinyl alcohol. If the Examiner disagrees, she should point with particularity to the relevant portions of *Schilling* in the Examiner's Answer.

Maruyama is directed to silane-containing polyvinyl alcohols. Unlike fully hydrolyzed polyvinyl alcohols, the silane-containing polyvinyl alcohols of *Maruyama* do not have a dissolution rate problem. Note column 8, lines 18-25. Rather, these polymers apparently dissolve quickly and easily. The problem with the *Maruyama* polymers is that they contain reactive silanes which are silanol-, acetoxy-, or alkoxy-functional. *See*, col. 6, ll. 23-28. These hydrolyzable groups are reactive with water, and lead to viscosity increases and

eventual gelling of the polyvinyl alcohol solution. *Maruyama*, for example, discloses siloxane bond formation by reaction of these groups, the siloxane bonds forming chain extended and crosslinked polymers, (Col. 7, ll. 61-64) and further alludes to solution instability at column 8, lines 23 - 25. This effect is also well known to the skilled artisan, and is illustrated by Example 1 and Comparative Example 1 in Table 3, where a silane-modified polyvinyl alcohol copolymer increased in viscosity (11% aqueous solution) from 25.1 mPa·s to 90.5 mPa·s in only two weeks, an increase of 360% (3.6x).

In the January 31, 2008 Office Action, Appellants comparative showing, at that time limited to the examples and comparative examples in the specification, were criticized on several grounds. Notably, the Examiner stated that the examples/comparative examples were not commensurate with the scope of the claims; second, the Examiner stated that the examples/comparative examples were not proper side-by-side examples because the composition of the comparative polyvinyl alcohol, Kuraray Poval® R-1130 was not presented in the form of a Declaration. Both these alleged deficiencies were cured by the Declaration of Dr. Bacher (Evidence Appendix).

In the Bacher Declaration (page 5), the Kuraray polymer POVAL® R-1130 is identified as a polyvinyl alcohol produced from vinyl acetate and 0.55 weight percent vinyltrimethoxysilane. Thus, the comparative example in the specification is indeed a valid side-by-side comparison. This comparative example will be discussed later.

In the Bacher Declaration, an additional subject invention example was performed, for purposes of comparing the stability of this polymer with the comparative polymer. This example employed a different silane (vinylmethyldiethoxysilane) than Example 1 (vinyltrithoxysilane). This example will be discussed later as well.

It is the position of the Office that one wishing to prepare a viscosity stable polyvinyl alcohol would be motivated to take a *Schilling* polyvinyl alcohol, having, in addition to vinyl alcohol repeating moieties, methylvinyl alcohol moieties (in amounts of 5 - 50%[4], and add the silane moieties of *Maruyama* to improve surface strength and printability of paper coated with coating slips employing such a polymer as a binder. However, as testified to by Dr. Bacher, this is incorrect, and one of ordinary skill in the art would not do this, as the expected result would be a polymer lacking viscosity stability, and an increase in production cost with no perceived benefit.

The Examiner belittles the latter economic disadvantage, claiming that economic benefit is of no patentable significance, citing *In re Farrenkopf*, 713 F.2d 714, 219 USPQ 1 (Fed. Cir. 1983). This is not, and has never been the law, and *Farrenkopf* does not stand for this proposition.

The entire purpose of the patent system is to provide the progress of the useful arts. Patents are commercial documents, designed to protect, for a limited time, commercially significant and patentable improvements. Patents are not mere pedagogical exercises. Especially in a capitalist economy, the economics of manufacturing are a commercial reality which is always seriously considered both by those skilled in the art as well as businessmen. No person in either category would be motivated to take an existing product such as silane-modified polyvinyl alcohol and make it more expensive for no reason - with no perceived benefit. This would be commercial suicide.

In *Farrenkopf*, the prior art taught that adding an inhibitor to Angiotensin I standards and reagents would have distinct benefits. One argument that the interference party *Farrenkopf* advanced was one skilled in the art would not be motivated to add such inhibitors

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[4]The amount of alkylvinyl alcohol units disclosed by *Schilling* is not commensurate with the claimed amounts of 1 - 30 mol%, but does overlap this range.

because they are costly. The Federal Circuit held that cost alone is of no patentable significance, when there are technological benefits which can result from adding the inhibitors. Stated another way, *Farrenkopf* stands for the proposition that when a change in a composition, process, etc., confers a benefit, then cost cannot be cited against such an improvement. The corollary, of course, is that when there is no perceived benefit, then cost is certainly highly relevant. In the commercial world, customers do not purchase a more expensive commodity if it has the same performance as a lesser cost competitor. To command a higher prices, there must be some benefit to justify the increased expense.

In the present case, it was desirable to provide a silane-modified polyvinyl alcohol for use in coating slips. The problem was that the commercial silane-modified polyvinyl alcohols did not have storage stability in aqueous solution. As indicated by the Example and Comparative Example 1 (fee Table 3 on page 13 of the application), the *Maruyama* polymer, containing 0.55 weight percent of vinyltrimethoxysilane units, exhibited a viscosity increase of 360% after 14 days, clearly indicating that the composition is not stable in aqueous solution. This is to be expected, since the Si-Bound alkoxy groups are subject to hydrolysis to ≡Si-OH groups, which can condense to siloxy groups ≡Si-O-Si≡. In this respect, please refer to the first full paragraph on page 3 of the Bacher Declaration, and to *Maruyama* himself at column 11, lines 39 - 42:

> The silicon atom to which alkoxyl or acyloxyl groups connect in the silicon-containing modified PVA or the silanol group or salt thereof which is their hydrolysate, readily self-condensate [and] crosslink. . . .

The problem addressed by Appellant is to improve the storage stability of polyvinyl alcohol polymers. This is neither the problem addressed by *Schilling* nor the problem addressed by *Maruyama*.

Schilling desired to provide polyvinyl alcohol copolymers which are readily soluble in water, and do not exhibit "pigment shock." As *Schilling* explains at the top of column 2, fully hydrolyzed polyvinyl alcohol polymers do not readily dissolve in water at room temperature, and must be heated to 90°C and stirred vigorously for a long time. Once dissolved, these solutions can be returned to room temperature without precipitation of polyvinyl alcohol, as is well known to those skilled in the art. Fully hydrolyzed polyvinyl alcohol polymers contain 1 hydroxyl group per repeating unit, and are thus <u>very</u> water soluble. The problem is the <u>rate</u> of dissolution, which is so slow at room temperature as to be virtually "insoluble". The time and temperature of the solution process generates considerable economic detriment.

Polyvinyl alcohols are also known to exhibit pigment shock, an undesirable high increase in viscosity upon initial addition of pigments, as used in considerable quantity in coating slips. This viscosity increase is temporary, but can only be relieved by the use of high shear stirring or addition of "anti-shock agents," both of which cause extra expense.

Schilling solved both these problems by incorporating 5 to 50 mol% of 1-alkylvinyl alcohol units into the polymer. The resultant polymers' dissolution rates are so high that they can be added in solid form to a pigment slurry and rapidly dissolve, whereas conventional polyvinyl alcohol does not. The pigment shock of these copolymers is also much less.

Maruyama is not directed to solving either of these problems. Rather, *Maruyama* is directed to providing a reactive polyvinyl alcohol by incorporating hydrolytically unstable alkoxysilane groups into the polymer. There is no dissolution-rate problem with the *Maruyama* polymers, nor any problem with pigment shock. However, the same reactive silane groups which solved *Maruyama's* problem generate an additional problem: solutions of *Maruyama's* polymers exhibit a viscosity increase in aqueous solution. This viscosity increase is attributable to the

silane alkoxy groups or their silanol hydrolysates condensing to form ≡Si-O-Si≡ siloxy crosslinking and chain-extending groups.

The question of non-obviousness cannot be viewed in a vacuum, or by hindsight reasoning. The issue here is whether one skilled in the art of polyvinyl alcohol slip binders, recognizing the stability problem of *Maruyama* and desiring to eliminate it, would modify a *Schilling* polvyinyl alcohol copolymer by incorporating alkoxysilane groups. Very clearly, neither *Schilling* nor *Maruyama* would direct one skilled in the art to Appellants' invention. Since those skilled in alkoxysilane technology recognize that it is the alkoxysilane groups of *Maruyama* which are responsible for the viscosity increase, one skilled in the art would certainly not be motivated to add alkoxysilane groups to a *Schilling* polymer. Why would one do this, knowing these groups would cause rather than prevent storage stability. Rather, one would search for other hydrophobicizing monomers such as long chain vinyl esters which do not have solution stability problems.

The Examiner turns this argument "on its ear" by her assertion that *Schilling* would be motivated to add *Maruyama* alkoxysilane groups to his polymer to obtain *Maruyama's* benefits. However, this argument is fallacious. The only reason *Schilling* incorporated 1-alkylvinyl alcohol groups into his polymers was to reduce pigment shock and provide high dissolution rates. If *Schilling* were motivated to add alkoxysilane groups, he would eliminate the 1-alylvinyl alcohol moieties, because there would be no reason for their presence. The *Maruyama* polymers are not taught by the art to have dissolution rate problems nor pigment shock. Thus, why incorporate an expensive 1-alkylvinyl alcohol comonomer into the polymer when there is no perceived benefit. One skilled in the art would agree that there is no perceived benefit to doing so. Thus, this is not a case such as *Farrenkopf*, where inclusion of an inhibitor, although expensive, was perceived to offer the possibility of improving the Angiotensin I standards and reagents. Here, one skilled in the art cannot conceive of any benefit; only the detriment of increased cost.

That this is so is borne out by the Bacher Declaration. .Dr. Bacher has four years of technical experience in polyvinyl alcohols, and several years of experience in the silanes field as well. Dr. Bacher indicates in paragraph 5, that unless faced with some reason for its use, one skilled in the art would not employ isopropenyl acetate (the precursor of the 1-methylvinyl alcohol repeating moieties) in manufacture of polyvinyl alcohol polymers. Dr. Bacher also indicates (¶6, page 3) that one skilled in the art would be dissuaded from doing so, by the known instability of *Maruyama* - type polymers, to include alkoxysilane groups in polyvinyl alcohols.

In paragraph 7, Dr. Bacher indicates that one skilled in the art would not be motivated to employ the 1-methylvinyl acetate monomer of *Schilling* to "solve a 'problem' which does not even exist, and that use of such a monomer with a silane comonomer would only increase cost "<u>without any known or perceived benefit</u>."

However, Dr. Bacher nevertheless investigated polyvinylalcohol copolymers containing both silane and 1-methylvinyl acetate comonomers, and very surprisingly found that the resulting copolymers were stable, and exhibited increased abrasion resistance as well. It cannot be said that solution rate or pigment shock was improved, since, unlike conventional polyvinyl alcohol copolymers, the *Maruyama* copolymers do not have these deficiencies. Dr. Bacher postulates why this is so in paragraph 6, based on sound scientific reasoning.

Almost 20 years passed between the first publication of the *Maruyama* and *Schilling* patent applications. It is too well known to require comment that there has been a continual demand for improved paper coatings, and their process of manufacture. This is especially so since the advent of modern personal computer printers and xerographic copiers which have placed demands upon coatings unlike those of the past. Both *Schilling* and *Maruyama* and the present application discuss the need for improved coatings and coating processes and raw materials. Yet despite the age of the references, no one prior to Appellants' produced a polyvinyl alcohol copolymer containing both 1-alkylvinyl alcohol moieties and silane

moieties. Why is this so? It is clearly because Appellants' invention is non-obvious over these references.

The Appellants' have provided examples supporting surprising and unexpected results. In the first appeal in this case, the amount of silane monomer was 0.01 to 10%, and the Board agreed with the Examiner that the showing was not commensurate with the scope of the claims. However, in the present application, the range of silane content is a narrow one, 0.01 to 1%, and both the *Maruyama* polymer and Appellants' two inventive examples, each employing a different silane, are squarely within this range. Both inventive copolymers, with different silanes, were exceptionally stable in solution. The *Maruyama* copolymer was not, exhibiting a high viscosity increase over time. Moreover, Dr. Bacher indicates (¶9) that this showing is believed to be commensurate with the ranges now claimed, and that there is no scientific reason to expect that the same surprising and unexpected results would not be achieved throughout the claimed range, which clearly includes both mol percentages and types of silane monomers. The Examiner has continued to contest this, but has given no technological reasons for her assertion.

2. <u>Separately for Claims 5 and 22</u>

Claims 5 and 22 further restrict the claimed silanes to vinyltrimethoxysilane, vinylmethyldimethoxysialne, vinyltriethoxysilane, and vinylmethyldiethoxysilane, all very closely chemically related silanes. The examples/comparative examples are clearly highly pertinent and commensurate in scope with this limited genus without room for argument.

Reversal of all rejections of record is respectfully solicited.

The fee of $540.00 as applicable under the provisions of 37 C.F.R. § 41.20(b)(2) is being charged to Deposit Account No. 02-3978 via electronic authorization submitted concurrently herewith. The Commissioner is hereby authorized to charge any fees or credit any overpayments as a result of the filing of this paper to Deposit Account No. 02-3978.

Respectfully submitted,

ANDREAS BACHER ET AL.

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Enclosure - Appendices

VIII. CLAIMS APPENDIX

1. A silane-containing polyvinyl alcohol polymer consisting essentially of a completely hydrolyzed or partially hydrolyzed vinyl ester copolymer having a degree of hydrolysis of from 75 to 100 mol%, obtained by free radical polymerization of

a) vinyl acetate and from 1 to 30 mol%, based on total polymer, of 1-methylvinyl acetate, and;

b) from 0.01 to 1 mol% of one or more silane-containing, ethylenically unsaturated monomers, and

c) hydrolysis of the polymers obtained thereby,

wherein the silane-containing, ethylenically unsaturated monomers is selected from the group consisting of ethylenically unsaturated silicon compounds of the general formula $R^1SiR^2_{0-2}(OR^3)_{1-3}$, in which each R^1 is independently $CH_2{=}CR^4\text{-}(CH_2)_{0-1}$ or $CH_2{=}CR^4CO_2(CH_2)_{1-3}$, each R^2 independently is a C_{1-3}-alkyl radical, C_{1-3} -alkoxy radical, or halogen, each R^3 independently is an optionally branched, optionally substituted C_{1-12} alkyl radical or a C_{2-12} acyl radical optionally interrupted by an ether group, and each R^4 is independently H or CH_3, a (meth)acrylamide containing silane groups of the formula $CH_2{=}CR^5\text{-}CO\text{-}NR^6\text{-}R^7\text{-}SiR^8_m\text{-}(R^9)_{3-m}$, in which m = 0 to 2, each R^5 is independently H or a methyl group, each R^6 is independently H or a C_{1-5} alkyl group, each R^7 is independently a C_{1-5} alkylene group or a bivalent organic group in which the carbon chain is interrupted by an O or N atom, each R^8 is independently a C_{1-5} alkyl group, and each R^9 is independently a C_{1-40} alkoxy group optionally containing further heteroatoms selected from the group consisting of O, N, S, or P, and mixtures thereof.

2. - 3. (cancelled)

4. The silane-containing polyvinyl alcohol of claim 1, having a Höppler viscosity according to DIN 53015, as 4% by weight aqueous solution of from 2 to 50 mPas.

5. The silane-containing polyvinyl alcohol of claim 1, wherein at least one silane-containing, ethylenically unsaturated monomers is selected from the group consisting of vinyltrimethoxysilane, vinylmethyldimethoxysilane, vinyltriethoxysilane, and vinylmethyldiethoxysilane.

6. The silane-containing polyvinyl alcohols of claim 1, wherein said polymerization is a mass polymerization, a suspension polymerization or a polymerization in organic solvents.

7. In a coating slip wherein a polymeric binder is employed, the improvement comprising selecting as at least one polymeric binder, a silane-containing polyvinyl alcohol of claim 1.

8. - 9. (cancelled)

10. In a coating slip wherein a polymeric binder is employed, the improvement comprising selecting as at least one polymeric binder, a silane-containing polyvinyl alcohol of claim 4.

11. In a coating slip wherein a polymeric binder is employed, the improvement comprising selecting as at least one polymeric binder, a silane-containing polyvinyl alcohol of claim 5.

12. A coating slip-coated substrate, comprising a substrate and the coating slip of claim 7.

13. The coating slip-coated substrate of claim 12, wherein the substrate comprises paper, plastics-coated paper, or a plastics foil.

14. The coating slip-coated substrate of claim 12, wherein the substrate is paper.

15. The coating slip-coated substrate of claim 12, wherein said coating slip-coated substrate is suitable for use in ink jet printing.

16. The polyvinyl alcohol of claim 1, wherein silane-containing ethylenically unsaturated monomers are copolymerized in an amount of from 0.01 to 1.0 mol percent.

17. A silane-containing polyvinyl alcohol polymer consisting of a hydrolyzed vinyl ester copolymer having a degree of hydrolysis of from 97.5 to 100 mol%, obtained by free radical polymerization of

a) a vinyl ester component comprising vinyl acetate and 1-methylvinyl acetate, and optionally wherein polymerized 1-methylvinylacetate comprise from 1 to 30 weight percent of the polymer, and

b) from 0.01 to 1 mol% of one or more silane-containing, ethylenically unsaturated monomers.

18. - 20. (cancelled)

21. The silane-containing polyvinyl alcohol of claim 17, wherein at least one silane-containing, ethylenically unsaturated monomers is selected from the group consisting of ethylenically unsaturated silicon compounds of the general formula $R^1SiR^2_{0-2}(OR^3)_{1-3}$, in which each R^1 is independently $CH_2=CR^4-(CH_2)_{0-1}$ or $CH_2=CR^4CO_2(CH_2)_{1-3}$, each R^2 independently is a C_{1-3}-alkyl radical, C_{1-3}-alkoxy radical, or halogen, each R^3 independently is an optionally branched, optionally substituted C_{1-12} alkyl radical or a C_{2-12} acyl radical optionally interrupted by an ether group, and each R^4 is independently H or CH_3, and a (meth)acrylamide containing

silane groups of the formula $CH_2=CR^5-CO-NR^6-R^7-SiR^8_m-(R^9)_{3-m}$, in which m = 0 to 2, each R^5 is independently H or a methyl group, each R^6 is independently H or a C_{1-5} alkyl group, each R^7 is independently a C_{1-5} alkylene group or a bivalent organic group in which the carbon chain is interrupted by an O or N atom, each R^8 is independently a C_{1-5} alkyl group, and each R^9 is independently a C_{1-40} alkoxy group optionally containing further heteroatoms selected from the group consisting of O, N, S, or P.

22. The silane-containing polyvinyl alcohol of claim 17, wherein at least one silane-containing, ethylenically unsaturated monomers is selected from the group consisting of vinyltrimethoxysilane, vinylmethyldimethoxysilane, vinyltriethoxysilane, and vinylmethyldiethoxysilane.

23. The coating slip of claim 7, comprising:

a) at least one pigment selected from the group consisting of silica, calcium carbonate, clay, bentonite, alumina, and titanium dioxide,

b) a cationic dispersant, and

c) from 10 to 50 weight percent based on solids of the silane-containing polyvinyl alcohol.

IX. EVIDENCE APPENDIX

1. Declaration of Dr. Andreas Bacher

X. RELATED PROCEEDINGS APPENDIX

None.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

ANDREAS BACHER, et al.

Group Art Unit: 1796

Examiner: Vickey M. Ronesi

Serial No.: 10/618,936

Filed: July 14, 2003

For: SILANE-CONTAINING POLYVINYL ALCOHOL FOR COATING SLIPS

Attorney Docket No.: WAS 0595 PUS

DECLARATION OF DR. ANDREAS BACHER

Mail Stop Amendment
Commissioner for Patents
U.S. Patent & Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

I. Dr. Andreas Bacher, do hereby declare and state as follows:

1. I am a co-inventor of the claimed subject matter of U.S. application Serial No. 10/618,936 filed July 14, 2003.

2. I obtained my Ph.D. in Macromolecular Chemistry from the University of Bayreuth, Germany in 1998. In 1998-99, I pursued post doctoral research at the University of Sheffield, England, and since January 1 of 2000 I have been employed by the assignee, Wacker Chemie AG. During my employment at Wacker Chemie, my research and development work was first in the filed of polyvinyl alcohols, particularly modified and functionalized polyvinyl alcohols, in emulsions, dispersions, and dispersible polymer powders for the construction and coatings markets, and in organosilicone nanoparticles. Since 2003, my research and development work is for the Silicone Division, particularly in the technical field of silicone rubber. I am the named inventor or co-inventor of numerous patents and their equivalents worldwide, including: U.S. 6,573,326; EP 1180535 B1; EP 1180529 B1; EP 1258464 B1; EP 1253157 A1; EP 1549682 B1; EP 1530595 B1; DE 10232664; U.S. 7,052,773; EP 1382621 B1;

DE 10320629; EP 1625177 B1; EP 1625254 B1; EP 1620271 B1; EP 1593721 A1; EP 1812478 A1; EP 1819742 A1.

3. I am familiar with the present application, its prosecution history, the recent Office Action, and the prior art.

4. In my opinion, based on my experience with polyvinyl alcohols and modified polyvinyl alcohols, one skilled in the art would not be motivated to prepare a polyvinyl alcohol copolymer also containing, in addition to vinyl acetate-derived vinyl alcohol moities, moieties derived from isopropenyl acetate (1-methylvinyl acetate) and unsaturated silane monomers, based on the teachings of Schilling and Maruyama.

5. Schilling desired to produce a polyvinyl alcohol copolymer which minimized pigment shock in producing coating slips and other highly pigment-loaded dispersions. To do so, Schilling incorporated isopropenyl acetate into his copolymer mixture, thus producing polymer containing isopropenyl alcohol units in addition to vinyl alcohol units. However, the use of isopropenyl acetate also involves a considerable cost penalty, since isopropenyl acetate is considerably more expensive than vinyl acetate, the monomer from which polyvinyl alcohols are generally prepared. Unless faced with some reason for its use, one skilled in the art would not employ isopropenyl acetate.

6. Maruyama discloses silane-modified polyvinyl alcohols prepared, in one method, by copolymerizing vinyl acetate and an unsaturated silane. The Maruyama copolymers are not known in the industry to exhibit marked pigment shock as are polyvinyl alcohols. A possible reason for this is that all the repeating moieties of polyvinyl alcohol, having pendant OH groups, are highly hydrophilic and offer the possibility of a great deal of hydrogen bonding with pigment surfaces, whereas in silane-modified polyvinyl alcohols, the regularity of repeating vinyl alcohol units is disrupted by the presence of random silane units, which also render these polymers less hydrophilic.

However, the silane-modified copolymers of Maruyama are known to suffer from viscosity stability in aqueous solution. This is shown in the present application by

the Comparative Example, wherein the viscosity of a Maruyama-type silane-modified polyvinyl alcohol, POVAL® R-1130, increased by a factor of more than 3 over storage of just 2 weeks.

In fact, one skilled in the art, reading the Maruyama specification, immediately recognizes that Maruyama desires rapid reaction of the silicon-bound alkoxy groups so that the Maruyama alkoxysilane-modified polyvinyl alcohol quickly reacts with cellulosic fibers, forming a gelled coating on the surface, which prevents further absorption of the coating composition into the paper. However, in an aqueous dispersion, the same high alkoxy-group reactivity is also responsible for the viscosity increase upon storage, due to chain extension and crosslinking through these alkoxy groups. Thus, based on Maruyama's teachings, one skilled in the art would be dissuaded from further modifying his silane-modified polyvinyl alcohols to be less reactive; rather one would wish them to be more reactive to provide even less penetration into the substrate. Applicants have proceeded in a direction opposite to the teachings of Maruyama, and yet achieved not only a more stable polymer, but produced higher abrasion resistance at the same time.

7. Schilling does not teach or suggest how to modify the polymers of Maruyama to solve their stability problem. Moreover, no one skilled in the art would be motivated to modify a Schilling isopropenyl alcohol moiety-containing polyvinyl alcohol, by incorporating an unsaturated silane into the polymerizable monomer mixture as taught by Maruyama. Prior to Applicants' invention, it was not known that incorporation of isopropenyl alcohol moieties into a silane-modified polyvinyl alcohol would increase its storage stability. This novel and useful feature was discovered by Applicants. Since the silane-modified polyvinyl alcohols are not known to suffer from pigment shock, there would be no reason to add the expensive isopropenyl acetate comonomer to solve a "problem" which does not even exist.

If Schilling, for example, were motivated to employ a silane-functional comonomer, there would be no reason apparent to Schilling, or more generally to anyone skilled in the art, to also employ isopropenyl acetate as a comonomer. Why would one do this? Unsaturated silane comonomers are themselves expensive. Including isopropenyl acetate as a comonomer would only increase cost without any known or perceived benefit.

8. The Examples and Comparative Examples illustrate the benefits of the subject invention. It was desired to increase abrasion resistance of coatings employing silane-modified polyvinyl alcohols without compromising the remaining properties and while retaining ease of production, including storage stability. See, e.g., page 9 of the Specification, last paragraph.

These objects are accomplished by including isopropenyl acetate as well as an unsaturated silane as comonomers with vinyl acetate to produce, by subsequent hydrolysis, a modified polyvinyl alcohol terpolymer. These polymers not only exhibited higher abrasion resistance than the polymers of Kuraray (Maruyama), but also exhibited simply outstanding viscosity stability. Both these results are completely surprising and unexpected based on the teachings of Schilling and Maruyama, whether alone or in combination.

9. The showing is believed to be commensurate with the present scope of the claims. In particular, the Examples and Comparative Examples are squarely within relatively narrow compositional ranges of the claimed terpolymers, and there is no scientific reason to expect that the same results would not be obtained throughout the claimed ranges.

10. To augment the previous showing, Example 1 was repeated with a different silane, vinylmethyldiethoxysilane, and compared with former Example 1 and Comparative Example 1. The makeup of the Kuraray POVAL® R-1130 is also set forth below. The Experiments were performed in the assignee's laboratories in Burghausen, Germany, as follows:

Example 1

612 g of water, 61.2 mg of copper(II) acetate and 61.2 g of a 5% strength polyvinylpyrrolidone solution (PVD-K90) in water were initially introduced under nitrogen into a thermostated laboratory apparatus having a capacity of 2.5 liters. A solution of 620 mg of tert-butyl per-2-ethylhexanoate (TBPEH 99% strength in water), 322 mg of tert-butyl perneodecanoate (Pergan PND 95% strength in water), 4.9 g vinyltriethoxysilane, 48.9 g of isopropenyl acetate and 42.8 g of isopropanol in 612 g of vinyl acetate were run in while stirring. The reactor was heated to 51.5°C and, after the reaction had diminished, was heated stepwise to

75°C. This temperature was maintained for a further 2 hours, after which cooling was carried out. The resulting polymer beads were filtered off with suction, washed thoroughly with water and dried.

In a laboratory reactor having a capacity of 2.5 liters, 90 g of polymer beads were dissolved in 810 g of methanol at 50°C. The solution was cooled to 30°C, a layer of 500 g of methanol was introduced on top with the stirrer stationary, and the methanolic NaOH was immediately added (i0 g of NaOH, 46% strength in water, dissolved in 90 g of methanol) and the stirrer was switched on.

The solution became increasingly turbid. During the gel phase, the stirrer was set to a higher speed in order to comminute the gel. After the gel phase, the reaction was allowed to continue for a further 2 hours, neutralization was effected with acetic acid and the solid form was filtered off, washed and dried. A completely hydrolyzed polyvinyl alcohol having a Höppler viscosity of 28 mPas (4% strength in water) was obtained.

Example 2

Example 2 was performed analogously to Example 1, with the difference that 5.0 g vinylmethyldiethoxysilane were applied instead of vinyltriethoxysilane. The respective hydrolyzed polyvinyl alcohol had a Höppler viscosity of 26 mPas (4% strength in water).

Comparative Example 1:

Commercial silane-containing polyvinyl alcohol (Poval R-1130 from Kuraray) from vinylacetate and 0.55 weight percent vinyltrimethoxysilane, based on total polymer, having a Höppler viscosity of 25 mPas (4% strength in water).

Testing of performance characteristics:

The polyvinyl alcohols from the example and comparative example were tested in the following formulations:

Formulation of coating slip for paper coating:

Precipitated silica	100 parts by weight
Polyvinyl alcohol	35 parts by weight
Cationic dispersant	5 parts by weight
Solids content of the coating slip:	20 - 35% by weight

The coating slip was tested on base paper: sized paper, 80 g/m^2. The coat was 15 g/m^2.

Formulation for coating slip for coating plastics foils:

Precipitated silica	100 parts by weight
Polyvinyl alcohol	34 parts by weight
Cationic dispersant	8 parts by weight
Polymer dispersion	50 parts by weight
Solids content of the coating slip:	20 - 28% by weight

The coating slip was tested on a 90 g/m^2 PET foil provided with an adhesion promoter. The coat was 15 g/m^2.

Abrasion test:

A 4.5 cm wide and 19 cm long coated paper strip or foil strip was processed by means of 50 strokes in an abrasion tester from Prüfbau (Dr. Dürner system) with a black drawing paper applied to a stamp (500 g).

The resulting black paper was then assessed visually, the rating 1 representing the optimum.

Brightness:

The brightness was determined by means of reflectance measurement using a R 457 filter and was visually assessed, the rating 1 representing the optimum.

Storage stability:

The storage stability was tested by storing in each case 11% strength aqueous solutions of the polyvinyl alcohols at a pH of 8.5 for up to 14 days and determining the Höppler viscosity (according to DIN 53015, as 4% strength by weight aqueous solution).

Table 1 (Results on paper):

Coat analysis	Example 1	Comparative Example 1	Example 2
Abrasion test	1.0	1.5	1.2
Brightness visual	1.0	1.0	1.0
Brightness R457	5.1	5.2	5.1

Table 2 (Results on plastics foil):

Coat analysis	Example 1	Comparative Example 1	Example 2
Abrasion test	1.0	1.5	1.1
Brightness visual	1.0	1.0	1.0
Brightness R457	5.3	5.3	5.3

Table 3 (Shelf life):

Storage time	Höppler viscosity [mPas]		
	Example 1	Comparative Example 1	Example 2
immediately	28.1	25.1	26.0
1 day	28.1	27.8	26.0
2 days	28.1	31.4	26.0
3 days	28.2	35.8	26.0
5 days	28.2	42.9	26.1
7 days	28.2	61.7	26.1
14 days	28.3	90.5	26.1

11. As can be seen, changing the silane from that of Example 1 did not change the terpolymer stability. Both the terpolymer of Example 1 and that of Example 2 exhibited excellent stability, whereas a copolymer of Kuraray exhibited a very considerable viscosity increase. These results are truly surprising and unexpected. No one skilled in the art would have expected that a terpolymer containing vinyl alcohol, isopropenyl alcohol, and silane moities would either be storage stable or produce the increase in abrasion resistance obtained.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

DR. ANDREAS BACHER

Dated: 05/19/08